

WHAT IS CLAIMED IS:

- 1 1. A method of performing a Fast Fourier Transform in a
2 data processing apparatus having a data cache smaller than the
3 data set of the Fast Fourier Transform, comprising the steps
4 of:
5 performing a first stage radix-R butterfly computations
6 on all the input data producing R independent intermediate
7 data sets;
8 successively performing second and all subsequent stage
9 butterfly computations on each independent intermediate data
10 set in turn producing corresponding output data.
- 1 2. The method of claim 1, wherein:
2 each of said R independent intermediate data sets fits
3 within the data cache.
- 1 3. The method of claim 1, wherein:
2 said radix-R is radix-2.
- 1 4. The method of claim 1, wherein:
2 said radix-R is radix-4.
- 1 5. The method of claim 1, wherein:
2 said step of performing a first stage radix-R butterfly
3 computations on all the input data includes
4 dividing said input data into R continuous sets, and
5 disposing said input data into memory, each R
6 continuous set in continuous memory locations with a

7 space in memory locations equal to the size of a cache
8 line between adjacent sets.

1 6. The method of performing an N-point radix-R Fast
2 Fourier Transform in a data processing apparatus having a data
3 cache comprising the steps of:
4 comparing the data set of input data and twiddle factors
5 with the size of the data cache;
6 if said data set is smaller than said data cache,
7 performing said Fast Fourier Transform in $\log_R N$ stages on all
8 the data set in one pass; and
9 if said data set is larger than said data cache but
10 smaller than R times the data cache
11 performing a first stage radix-R butterfly
12 computations on all the input data producing R
13 independent intermediate data sets in a first pass;
14 successively performing second and all subsequent
15 stage butterfly computations on each independent
16 intermediate data set in turn producing corresponding
17 output data in second passes.

1 7. The method of claim 6, wherein:
2 said Fast Fourier Transform uses complex input data and
3 complex twiddle factors of M bytes each; and
4 said step of comparing the data set with the size of the
5 data cache compares the data cache size to $4 N \times M$ bytes.

1 8. The method of claim 6, wherein:
2 said radix-R is radix-2.

1 9. The method of claim 6, wherein:
2 said radix-R is radix-4.

1 10. The method of claim 6, wherein:
2 said step of performing a first stage radix-R butterfly
3 computations on all the input data includes
4 dividing said input data into R continuous sets, and
5 disposing said input data into memory, each R
6 continuous set in continuous memory locations with a
7 space in memory locations equal to the size of a cache
8 line between adjacent sets.

1 11. The method of claim 6, further comprising:
2 if said data set is larger than R times the data cache
3 performing I initial stages of radix-R butterfly
4 computations on all the input data producing R
5 independent intermediate data sets, where I is the next
6 integer greater than $\log_R(D/C)$, D is the size of the data
7 set and C is the size of the cache; and
8 successively performing all subsequent stage
9 butterfly computations on each independent intermediate
10 data set in turn producing corresponding output data in
11 second passes.